CLAIMS

1. An automated or semi-automated system for optimising the production performance of a milk producing animal herd comprising a plurality of individual herd members each assigned a unique identification code that is recognisable by the system, the system comprising the following interconnected means:

(a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system,

(b) means for recognising the identification code of the individual herd member,

(c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles,

(d) means for analysing a plurality of compounds or parameters in a milk sample being collected, said means comprising:

(i) separate means for analysing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual milk compound or parameter,

(ii) means for directing a part of the milk sample to each separate analysing means, said directing means being controlled by said means for storing data for the physiological and nutritional state of each individual herd member such that the directing means is only activated at pre-selected points in time or at pre-selected time intervals in the reproduction or lactation cycles,

(iii) means for detecting signals generated in the presence of a compound or parameter being analysed,

(e) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member,

(f) means for storage of said set of data descriptive of the physiological and/or nutritional condition for said individual herd members, and

(e) data output means.

2. A system according to claim 1 where the sample collecting means is adapted to collect a milk sample from an individual mammary gland of a herd member.

3. A system according to claim 1 where the sample collecting means is adapted to collect a sample combining milk from two or more mammary glands of a herd member.

4. A system according to claim 2 or 3 where the sample collecting means is capable of collecting a proportional milk sample.

5. A system according to claim 2 or 3 where the sample collecting means is capable of collecting a subsample during a pre-selected time interval of the milking operation.

6. A system according to claim 1 where the sample collecting means comprises means for storing a milk sample being collected.

7. A system according to claim 6 where the means for storing a milk sample comprises mixing means.

8. A system according to any of claims 1-3 or 6 where the sample collecting means further comprises or is operationally connected with at least one of (i) means permitting the sample collecting means to be cleaned between samples, (ii) means for storing a buffer solution or a dilute solution, (iii) means for connecting the means for storing a milk sample to the analytical means, the means for storing a buffer solution or the dilute solution, the milking system and/or a sample discharge outlet, (iv) means for controlling the temperature of the milk sample being collected and (v) means for transporting the milk sample being collected.

9. A system according to any of claims 1-3 or 6 where the sample collecting means comprises means for storing a plurality of milk samples.

10. A system according to claim 9 where the means for storing a plurality of milk samples is in the form of a device comprising a plurality of milk storage containers.

11. A system according to claim 10 where the device comprising a plurality of milk storage containers is insertable into the milk collecting means prior to collecting milk samples and is removable herefrom when the plurality of samples is collected for bringing it into operational contact with the analytical means.

12. A system according to claims 6 or 7 where the means for storing a milk sample has a pressure that is different from the pressure of the milking system to which said means is connected.

13. A system according to any of claims 1-3 or 6 where the means for collecting a milk sample is connected to an element of the milking system selected from the group consisting of a teat cup, a teat tube, a milk metering device and a milk transporting tube.

14. A system according to claim 13 where the means for collecting a milk sample is connected to a tubing element of the milking system, said means is optionally provided with a separate milk metering device.

15. A system according to claim 1 where the separate means for analysing individual compounds or parameters in the milk sample includes means for analysing at least one compound or parameter selected from the group consisting of a compound or parameter that is indicative of mastitis, a compound or parameter that is indicative of the reproduction cycle state of the milking animal and a compound or parameter that is indicative of the energy and nutritional state of the milking animal.

16. A system according to claim 15 comprising separate analysing means for analysing a compound or parameter indicative of mastitis that is selected from the group consisting of somatic cells, microbial cells or parts thereof, an enzyme, a protein, a lipid, a mineral, a trace element, milk temperature, conductivity of the milk and a particle that is separable by filtration.

17. A system according to claim 16 where the compound indicative of mastitis is an enzyme, the amount of which is increased in milk from an inflamed mammary gland.

18. A system according to claim 17 where the enzyme is selected from the group consisting of lactate dehydrogenase (LDH) and beta-N-acetylglucosaminidase (NAGase) E.C. 3.2.1.52.

19. A system according to claim 18 where the separate analysing means for analysing NAGase is capable of detecting an amount of NAGase which is in the range of 0 to 0.1 U/ml and/or an amount of LDH which is in the range of 100 to 2000 U/ml.

20. A system according to claim 15 comprising separate analysing means for analysing a compound or parameter, the presence or amount of which in milk is indicative of the re-

production cycle state of the milking animal that is selected from the group consisting of a compound that indicates pro-oestrus, a compound that is indicative of oestrus (heat), a compound that indicates di-oestrus and a compound that indicates pregnancy.

21. A system according to claim 20 where the compound indicative of the reproduction cycle state of the milking animal is a hormone.

22. A system according to claim 21 where the hormone to be analysed is progesterone.

23. A system according to claim 22 where the separate analysing means for analysing progesterone is capable of detecting an amount hereof in the milk sample which is in the range of 0 to 30 ng/ml, including 0 to 20 ng/ml.

24. A system according to claim 15 comprising separate analysing means for analysing a compound or parameter indicative of the energy and/or nutritional state of the milking animal that is selected from the group consisting of a compound or parameter that is indicative of the protein balance of the milking animal and a compound or parameter that is indicative of the overall energy balance of the milking animal.

25. A system according to claim 24 where the compound or parameter that is indicative of the protein balance of the milking animal is selected from the group consisting of milk urea nitrogen (MUN) and total milk protein.

26. A system according to claim 25 where the separate analysing means for analysing a compound or parameter that is indicative of the protein balance of the milking animal is capable of detecting an amount of MUN which is in the range of 0 to 1000 mg/l including 0 to 700 mg/l.

27. A system according to claim 24 where the compound or parameter that is indicative of the overall energy balance of the milking animal is selected from the group consisting of a ketone body compound and total milk fat content.

28. A system according to claim 27 where the ketone body compound is selected from the group consisting of acetolactate, beta-hydroxybutyrate (BOHB) and acetone.

29. A system according to claim 28 where the analysing means for analysing a compound or parameter that is indicative of the overall energy balance of the milking animal is capable of detecting an amount of BOHB which is in the range of 0 to 0.7 mM.

30. A system according to claim 1 where the separate means for analysing an individual compound or parameter in the milk sample include means for analysing at least one compound selected from the group consisting of NAGase, progesterone, milk urea nitrogen, total protein content, BOHB, total fat content and milk yield.

31. A system according to any of claims 1-3, 6 or 15 where the means for analysing a plurality of compounds or parameters in a milk sample is analytically linked to a plurality of means for collecting a milk sample.

32. A system according to claim 31 where milk samples collected by the plurality of means for collecting a milk sample is transported to the means for analysing a plurality of compounds or parameters in a milk sample via a tube element, via a conveyer element or by hand.

33. A system according to claim 31 where the means for analysing a plurality of compounds or parameters in a milk sample is spatially separated form the plurality of means for collecting a milk sample.

34. A system according to claim 32 where each individual milk sample is collected in an enclosure element.

35. A system according to any of claims 1-3, 6 or 15 where means for analysing a plurality of compounds or parameters is placed at each milking site.

36. A system according to claim 1 where the data storage means comprises a database containing for each individual herd member multiple data related to previous analyses of milk samples from herd members for the presence of individual compounds or parameters.

37. A system according to claim 36 where the multiple data include data selected from the group consisting of data for identifying the milking site, milk yield data, data to identify the individual herd members, data related to parity, reproduction state and lactation state of the herd members including data indicating points in time in the reproduction and lactation cycles, data for time of sample collections, historical analytical data for the physiological and nutritional state, historical data for compositions of milk samples, feeding scheme data, disease rec??ord data including data for previous disease treatments.

38. A system according to claim 36 where the data storage means is, or is operationally linked to, a data management system that is capable of comparing real time analytical data received from the signal detection means with data stored in the data storage means

and, based thereupon, generating and transmitting an instruction message to the herd manager.

39. A system according to claim 1 or 38 where the data storage means is operably linked to a database comprising historical data descriptive of the physiological and nutritional condition collected from members of one or more different milk producing animal herds, said database either being part of the system or being an external database operationally linked to the system.

40. A system according to claim 39 where the external database is operationally linked to the system via the internet.

41. A system according to claim 38 where the instruction message indicates that a specific herd member is ready for insemination.

42. A system according to claim 38 where the instruction message indicates that a specific herd member is in need of mastitis treatment.

43. A system according to claim 38 where the instruction message indicates that at least one specific herd member is in need of a feeding scheme adjustment.

44. A system according to claim 38 where the recipient of the instruction message is a pre-selected specialist including a farmer, a veterinarian, an inseminator or a farm management consultant.

45. A system according to claim 1 where the analysing means comprises means for performing an analysis selected from the group consisting of an enzymatically based assay, an immunologically based assay, a biosensor analysis, a biochemical assay, a spectrometric assay and a flow injection based assay.

46. A system according to claim 45 where the analysing means comprises solid support analytical devices.

47. A system according to claim 46 where the analysing means comprises or is operationally linked to means for storing and transporting the solid support analytical devices.

48. A method for optimising the production performance of a milk producing animal herd using the system according to any of claims 1-3, 6, 15, 36 or 41, the method comprising the steps of:

(i) collecting at a milking site a milk sample from each individual member of the herd,

(ii) contacting said sample with the analysing means that, in the presence of at least one compound or parameter indicative of the physiological and/or nutritional condition of the herd member, generates a detectable signal/detectable signals,

(iii) recording in the signal detection means the character of said signal(s) to provide a set of analytical data indicative of the presence and/or amount of said compound or parameter,

(iv) having the generated data processed to provide a set of data descriptive of the physiological and/or nutritional condition of the individual herd member, and

(v) taking, on the basis of the set of data provided, appropriate steps to improve or correct the physiological and/or nutritional condition of any of the herd members in need of such improvement or correction.

49. A method for optimising the production performance of a milk producing animal herd comprising a plurality of individual herd members using an automated or semi-automated system for optimising the production performance of a milk producing animal herd, the system comprising the following interconnected means:

(a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system,

(b) means for recognising a unique identification code assigned to each of the individual herd member,

(c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles,

(d) means for analysing a plurality of compounds or parameters in a milk sample being collected, said plurality of compounds or parameters at least including a compound or parameter indicative of mastitis, a compound indicative of the reproduction cycle state, at least one compound indicative of the protein balance of the herd member and at least one compound indicative of the energy balance state of the herd member, said analysing means comprising

(i) separate means for analysing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual milk compound or parameter, and

(ii) means for detecting signals generated in the presence of a compound or parameter being analysed,

(e) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member,

(f) means for storage of said set of data descriptive of the physiological and/or nutritional condition for said individual herd members, and

(e) data output means,

the method comprising the steps of:

(i) collecting at a milking site a milk sample from each individual member of the herd,

(ii) contacting said sample with the analysing means that, in the presence of at least one compound or parameter indicative of the physiological and/or nutritional condition of the herd member, generates a detectable signal/detectable signals,

(iii) recording in the signal detection means the character of said signal(s) to provide a set of analytical data indicative of the presence and/or amount of said compound or parameter,

(iv) having the generated data processed to provide a set of data descriptive of the physiological and/or nutritional condition of the individual herd member, and

(v) taking, on the basis of the set of data provided, appropriate steps to improve or correct the physiological and/or nutritional condition of any of the herd members in need of such improvement or correction.

50. A method according to claim 49 using a system where the sample collecting means is adapted to collect a milk sample from an individual mammary gland of a herd member.

51. A method according to claim 49 using a system where the sample collecting means is adapted to collect a sample combining milk from at least two mammary glands of a herd member.

52. A method according to claim 50 or 51 using a system where the sample collecting means is capable of collecting a proportional milk sample.

53. A method according to claims 50 or 51 using a system where the sample collecting means is capable of collecting a subsample during a pre-selected time interval of the milking operation.

54. A method according to claim 49 using a system where the sample collecting means comprises means for storing a milk sample being collected.

55. A method according to claim 54 using a system where the means for storing a milk sample comprises mixing means.

56. A method according to claims 49 or 54 using a system where the sample collecting means further comprises, or is operationally connected with, at least one of (i) means permitting the sample collecting means to be cleaned between samples, (ii) means for storing a buffer solution or a dilute solution, (iii) means for connecting the means for storing a milk sample to the analytical means, the means for storing a buffer solution or the dilute solution, the milking system and/or a sample discharge outlet, (iv) means for controlling the temperature of the milk sample being collected and (v) means for transporting the milk sample being collected.

57. A method according to claims 49 or 54 using a system where the sample collecting means comprises means for storing a plurality of milk samples.

58. A method according to claim 57 using a system where the means for storing a plurality of milk samples is in the form of a device comprising a plurality of milk storage containers.

59. A method according to claim 58 using a system where the device comprising a plurality of milk storage containers is inserted into the milk collecting means prior to collecting milk samples and is removed herefrom when the plurality of samples is collected for bringing it into operational contact with the analytical means.

60. A method according to claims 54 or 55 using a system where the means for storing a milk sample has a pressure that is different from the pressure of the milking system to which said means is connected.

61. A method according to any of claims 49 or 54 using a system where the means for collecting a milk sample is connected to an element of the milking system selected from the group consisting of a teat cup, a teat tube a milk flow metering device, and a milk transporting tube.

62. A system according to claim 61 where the means for collecting a milk sample is connected to a tubing element of the milking system and is provided with a separate milk flow meter.

63. A method according to claim 49 where the compound indicative of mastitis is an enzyme, the amount of which is increased in milk from an inflamed mammary gland.

64. A method according to claim 63 where the enzyme is selected from the group consisting of lactate dehydrogenase (LDH) and beta-N-acetylglucosaminidase (NAGase) E.C. 3.2.1.52.

65. A method according to claim 64 using a system where the analysing means for analysing NAGase is capable of detecting an amount of NAGase which is in the range of 0 to 0.1 U/ml and/or an amount of LDH which is in the range of 100 to 2000 U/ml.

66. method according to claim 49 using a system comprising separate analysing means for analysing a compound or parameter, the presence or amount of which in milk is indicative of the reproduction cycle state of the milking animal that is selected from the group consisting of a compound that indicates pro-oestrus, a compound that is indicative of oestrus (heat), a compound that indicates di-oestrus and a compound that indicates pregnancy.

67. A method according to claim 66 where the compound indicative of the reproduction cycle state of the milking animal is a hormone.

68. A method according to claim 67 where the hormone to be analysed is progesterone.

69. A method according to claim 68 using a system comprising analysing means for analysing progesterone that is capable of detecting an amount hereof in the milk sample which is in the range of 0 to 30 ng/ml including 0 to 20 ng/ml.

70. A method according to claim 49 using a system where the compound or parameter that is indicative of the protein balance of the milking animal is selected from the group consisting of milk urea nitrogen (MUN) and total milk protein.

71. A method according to claim 70 using a system where the analysing means for analysing a compound or parameter that is indicative of the protein balance of the milking animal is capable of detecting an amount of MUN which is in the range of 0 to 1000 mg/l including 0 to 700 mg/l.

72. A method according to claim 49 where the compound or parameter that is indicative of the overall energy balance of the milking animal is selected from the group consisting of a ketone body compound and total milk fat content.

73. A method according to claim 72 where the ketone body compound is selected from the group consisting of acetolactate, beta-hydroxybutyrate (BOHB) and acetone.

74. A method according to claim 73 using a system where the analysing means for analysing a compound or parameter that is indicative of the overall energy balance of the milking animal is capable of detecting an amount of BOHB which is in the range of 0 to 0.7 mM including 0.1 to 0.7 mM.

75. A method according to any of claims 49, 54 or 63 using a system where the means for analysing a plurality of compounds or parameters in a milk sample is analytically linked to a plurality of means for collecting a milk sample.

76. A method according to claim 75 where milk samples collected by the plurality of means for collecting a milk sample is transported to the means for analysing a plurality of compounds or parameters in a milk sample via a tube element, via a conveyer element or by hand.

77. A system according to claim 75 where each individual milk sample is collected in an enclosure element.

78. A method according to claim 75 where the means for analysing a plurality of compounds or parameters in a milk sample is spatially separated form the plurality of means for collecting a milk sample.

79. A method according to claim 49 using a system where the data storage means comprises a database containing for each individual herd member multiple data related to previous analyses of milk samples from herd members for the presence of individual compounds or parameters.

80. A method according to claim 79 where the multiple data include data selected from the group consisting of data for identifying the milking site, milk yield data, data to identify the individual herd members, data related to parity, reproduction state and lactation state of the herd members including data indicating points in time in the reproduction and lactation cycles, data for time of sample collections, historical analytical data for the physiological and nutritional state, historical data for compositions of milk samples, feeding scheme data, disease record data including data for previous disease treatments.

81. A method according to claim 79 where the data storage means is, or is operationally linked to, a data management system that is capable of comparing real time analytical data received from the signal detection means with data stored in the data storage means and, based thereupon, generating and transmitting an instruction message to the herd manager.

82. A method according to claim 49 or 81 using a system where the data storage means is operationally linked to a database comprising historical data descriptive of the physiological and nutritional condition collected from members of one or more different milk producing animal herds, said database either being part of the system or an being an external database operationally linked to the system.

83. A system according to claim 82 where the external database is operationally linked to the system via the internet.

84. A method according to claim 81 where the instruction message indicates that a specific herd member is ready for insemination or becomes pregnant.

85. A method according to claim 81 where the instruction message indicates that a specific herd member is in need of mastitis treatment.

86. A method according to claim 81 where the instruction message indicates that at least one herd member is in need of a feeding scheme adjustment.

87. A method according to claim 81 where the recipient of the instruction message is a pre-selected specialist including a farmer, a veterinarian or a farm management consultant.

88. A method according to claim 49 using a system where the analysing means comprises means for performing an analysis selected from the group consisting of an enzymatically based assay, an immunologically based assay, a biosensor analysis, a biochemical assay, a spectrometric assay and a flow injection based assay.

89. A method according to claim 88 where the analysing means comprises solid support analytical devices.

90. A method according to claim 89 where the analysing means comprises or is operably linked to means for storing and transporting the solid support analytical devices.

91. An apparatus for analysing a plurality of compounds or parameters in a milk sample of an individual member of a milk producing animal herd, said apparatus comprising:

(i) separate means for analysing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual sample compound or parameter,

(ii) means for directing a part of the milk sample to each separate analysing means, said directing means being controlled by means for storing data for the physiological and nutritional state of each individual herd member, including data indicating point in time in the reproduction and lactation cycles of said herd member, such that the directing means is only activated at pre-selected points in time or at pre-selected time intervals in the production or lactation cycles of the individual herd member.

92. An apparatus according to claim 91 further comprising means for detecting signals generated in the presence of a compound or parameter being analysed,

93. An apparatus according to claim 91 or 92 provided with means for connecting it with at least one of:

(a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system,

(b) means for recognising an identification code of the individual herd member,

(c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles,

(d) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member,

(e) means for storage of said set of data descriptive of the physiological and/or nutritional condition for said individual herd members, and

(f) data output means.